

Application Number 10/531,367  
Amendment dated July 2, 2008  
Response to Office action of April 3, 2008

### Remarks/Arguments

Applicant notes that the Claim amendments submitted in the Preliminary Amendment dated April 13, 2005 appear to have been entered; however, amendments to the Specification appear not to have been. Applicant requests that the amendments be entered.

### Priority

Applicant believes that the effective priority date of the current application is that of the case to which it is a Continuation-in-Part, namely U.S. Patent Application No. 10/508,914.

### Claim Objections

Claim 16 is objected to as unsupported by the specification. Examiner asserts that "the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section is in the range  $10 - 100\lambda$ ", which is disclosed in paragraph [0021] of the Patent Application Publication, and which for the avoidance of doubt, Applicant repeats below:

"Referring now to Figure 3, which depicts one embodiment for a tunnel barrier of the present invention, two materials 40 and 42 are separated by the thin electrical insulator material 44. The insulator material can be any one of a number of materials such as  $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{Al}_2\text{O}_3$  or titanium oxide. Materials 40 and 42 may be the same or different, and may be either semiconductors or metals. A variety of suitable semiconductors are known and include  $\text{Bi}_2\text{Te}_3$  and its Sb- and Se- doped phases,  $\text{Bi}_{1-x}\text{Sb}_x$ , and  $\text{CoSb}$ . The interface 46 between materials 40 and 42 is indented/protruded as shown. The depth of the indentations at this interface are  $a$ , and the width is much more than  $\lambda$ , where  $\lambda$  is the de Broglie wavelength. Typically  $a$  is in the range of  $10-100\lambda$ . The value for  $a$  is chosen to set a threshold energy value above which the barrier is transparent to electron flow, and below which electron flow is prevented."

Here it is clearly stated that in Figure 3 the depth of the indentations in the interface 46 are  $a$ , and that  $a$  is in the range of  $10-100\lambda$ . Interface 46 is the tunnel barrier of claim 1.

Applicant requests that Examiner withdraw the objection to claim 16 because of informalities.

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### **Claim Rejections – 35 USC 112**

Claim 5 is rejected since it contains a relative term that renders the claim indefinite. Claim 5 has accordingly been canceled.

### **Claim Rejections – 35 USC 102**

To anticipate a claim, the prior art reference must teach every aspect of the claim. Furthermore the alleged identical invention must show in as complete detail as is shown in the supposedly anticipated claim.

### **Rejection of claims 1-2, 6-12, 14, 16, 18 and 20 under 35 USC 102 (b) as being anticipated by Ghoshal (WO 02/47178).**

Claims 1-2, 6-12, 14, 16, 18 and 20 stand rejected under 35 USC 102 (b) as being anticipated by Ghoshal (WO 02/47178).

The present application claims priority from U.K. application No. GB0224300.4, filed October 20, 2002, less than a year after Ghoshal was published (June 13, 2002). Furthermore, this application is a continuation-in-part of U.S. Patent Application No. 10/508,914, whose earliest priority date is March 22, 2002, which is before Ghoshal was published. Ghoshal would not therefore appear to be relevant prior art.

Ghoshal teaches the coupling of thermoelements (210 and 212) to electrical conductors (218 and 220) via a plurality of tips (250) on the surface of the thermoelements, wherein the topography of the tips is a zig-zag shape (Figs. 2, 4, 5, 6, 7, 11, 13)

Regarding claim 1, it can be seen from Figures 2, 3 and 4 of the present invention and the associated descriptive text (paragraph [0020]), that the walls of the indented/protruded structure are stepped, and that the walls of the indents / protrusions are perpendicular to one another; this is not taught in the prior art reference, in which there is a zigzag structure. Applicant has amended claim 1 to make the scope of the present invention more clear. In view of these arguments, Applicant requests that Examiner's rejection of claims 1, 2, 6-12, 14, 16, 18 and 20 as being anticipated by Ghoshal be withdrawn.

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Furthermore, regarding claim 2, Examiner asserts that Ghoshal teaches that the depth of indents in said indented cross-section or the height of protrusions in said protruded cross-section to be chosen to set a threshold energy above which the barrier is transparent to electron flow, and below which electron flow is prevented, and cites page 9, paragraph 2, reproduced below:

*Another advantage of the cold point structure is that the electrons are confined to dimensions smaller than the wavelength (corresponding to their kinetic energy). This type of confinement increases the local density of states available for transport and effectively increases the Seebeck coefficient. Thus, by increasing and decreasing 8, the figure of merit ZT is increased.*

What Ghoshal means by "increasing and decreasing 8" is not clear as there is no teaching as to the identity of element "8" in Ghoshal's teaching. Applicant asserts that the alleged identical invention does not show in as complete detail as is shown in the supposedly anticipated claim, as it must in order to anticipate the claim. In relation to claim 2, Examiner further refers applicant to Figure 14, which appears to show a tip 1402 separated from an opposing surface 1404 by a distance  $d$ ; this last teaching would appear to have no relevance to the present invention, as there is no separation between anything approximating to a tip and an opposing surface. In addition, Ghoshal does not teach a tip height of  $\lambda(1+2n/4)$ ; to anticipate a claim, the prior art reference must teach every aspect of the claim, and here it does not.

Furthermore, regarding claim 7, Examiner further refers applicant to Figure 14, which appears to show a tip 1402 separated from an opposing surface 1404 by a distance  $d$ ; this last teaching would appear to have no relevance to the present invention, as there is no separation between anything approximating to a tip and an opposing surface.

Furthermore, regarding claim 11, Examiner argues that Ghoshal's evacuation of the area around the tips reads on the formation of an electrically insulating material, as recited in this claim. However, given this interpretation, Applicant fails to understand how Ghoshal satisfies part c) of the method recited in claim 11, wherein a second thermoelectric material is attached to said insulating material, since it is nonsense to refer to attaching anything to a vacuum.

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Furthermore, regarding claim 16, the claim as stands makes reference to indent depth, not width. To anticipate a claim, the prior art reference must teach every aspect of the claim. Furthermore the alleged identical invention must show in as complete detail as is shown in the supposedly anticipated claim – Ghoshal has no detail of similar quality concerning indent depth.

In view of the amendment made to claim 1 and the arguments above, Applicant respectfully requests that Examiner withdraw his rejection of claims 1-2, 6-12, 14, 16, 18 and 20 under 35 USC 102 (b) as being anticipated by Ghoshal.

**Rejection of claims 1-5 under 35 USC 102 (b) as being anticipated by Tavkhelidze (US6281214).**

Claims 1 – 5 stand rejected under 35 USC 102 (b) as being anticipated by Tavkhelidze (US 6, 281, 514).

In relation to claim 1, Examiner asserts that in Figure 2, Tavkhelidze teaches a potential barrier having an indented or protruded surface (17). In point of fact, Figure 2 is a diagrammatic representation of a notional surface 17 separating two domains (column 4, lines 26-30 and 51,51) set forth in order to explain theory behind the behavior of the surface, rather than a physical object (embodiments of a physical object are taught by Tavkhelidze in Figure 5). In column 4, lines 60-67, Tavkhelidze teaches that leakage of electrons through a barrier may occur with increased probability and may promote tunneling and transfer of electrons across a potential barrier. Tavkhelidze also suggests that this might open many new possibilities for different practical applications and provides some detail on indent height for a surface of a semiconductor domain (column 5, lines 10-30), there is no detailed teaching that such a surface may be used to control the movement of electrons *through* a thermoelectric material. Tavkhelidze does not therefore teach in as complete detail as is shown in the supposedly anticipated claim, as the alleged identical invention must in order to anticipate. A mere indication that something might be useful with no equivalent teaching on how it might be done cannot be considered to be anticipation – there has to be clear and definite teaching of the supposedly anticipated claim in the alleged identical invention

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In view of the arguments above Applicant respectfully requests that Examiner withdraw his rejection of claims 1 – 5 under 35 USC 102 (b) as being anticipated by Tavkhelidze.

**Claim Rejections – 35 USC 103(a)**

**Rejection of claims 13, 17 and 19 under 35 USC 103 as being anticipated by Ghoshal in view of Saida (5,866,930)**

Claims 13, 17 and 19 stand rejected under 35 USC 103(a) as being unpatentable over Ghoshal in view of Saida (5,866,930).

In view of the amendments made to claim 1 and the corresponding arguments above in relation to claims on which claims 13, 17 and 19 are dependent, Applicant believes that claims 13, 17 and 19 are patentable over the prior art of Ghoshal in view of Saida.

Furthermore, Applicant believes that Ghoshal and Saida themselves teach away from the suggested combination. Ghoshal's tips are maintained at a distance from the opposing surface rather than in physical contact, whereby electrical conductivity is maintained by tunneling but thermal conductivity is reduced, thereby increasing efficiency (Fig. 14, and pp. 16, 2<sup>nd</sup> and 3<sup>rd</sup> paragraphs). There is no suggestion or motivation to provide an electrical insulator such as silicon dioxide, via thermal oxidation or otherwise as taught by Saida, in the gap between the tips and opposing surface since this would serve to increase thermal conductivity between the tips and surface and reduce the efficiency of Ghoshal's invention. Thus, the proposed modification of Ghoshal in view of Saida would render Ghoshal unsatisfactory for its intended purpose.

In light of the arguments above, Applicant respectfully requests that Examiner withdraw his rejection of claims 13, 17 and 19 under 35 USC 103 (a).

**Rejection of claim 15 under 35 USC 103 as being anticipated by Ghoshal in view of Brannon**

Claim 15 stands rejected under 35 USC 103(a) as being unpatentable over Ghoshal in view of Brannon.

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In view of the amendments made to claim 1 and the arguments above regarding claim 11 (on which claim 15 is dependent), Applicant believes that claim 15 is patentable over the prior art of Ghoshal in view of Brannon.

Applicant therefore respectfully requests that Examiner withdraw his rejection of claim 15 under 35 USC 103 (a).

Applicant respectfully submits that this application, as amended, is in condition for allowance, and such disposition is earnestly solicited. No new material has been added by these amendments. If the Examiner believes that discussing the application the Applicant over the telephone might advance prosecution, Applicant would welcome the opportunity to do so.

Respectfully submitted,

/A.Tavkhelidze/

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Inventor